

6-15

MEMORANDUM

To: Jesse Silva
From: Dick Rhone *(initials)*
Date: February 26, 1988
Subject: Water Balance in Imperial Irrigation District

As we discussed, there are attached several tables relating to the Imperial Irrigation District Water Balance.

Tables 1, 2 and 3 show the water balance computed by this firm in 1985, updated through 1986.

Table 4 presents detailed data for the IID water balance for the period 1982-1986.

Table 5 (3 sheets) illustrates the effect on the balance of changing any item.

The tailwater value as derived is a residual number and as such inherits all of the errors of all estimates. We show that tailwater plus leaching is 466,000 acre-feet in 1986. Using a value for leachwater of 280,000 acre-feet indicates tailwater is 186,000 acre-feet. At 15% of crop deliveries tailwater is $(2,193,000 \times .15)$ 329,000 acre-feet, a difference of 143,000 acre-feet. If I had to guess I would say that our estimate of canal seepage (based on USGS & DWR) is high, consumptive use of rainfall by crops is low and the leaching value of 280,000 should be revised to reflect leaching by unconsumed rainfall.

Give me a call when you want to discuss these tables.

.cc: James L. Welsh

3-8-88 MEET w/ RHONE
TO GO OVER (8:00 AM)
JFS

TABLE /
WATER BALANCE
OF IMPERIAL VALLEY
1975-1986

(Values in Thousands of Acre-Feeet)

Water Requirement	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
Supply												
Colorado River inflow at Drop No. 4	2,934	2,741	2,664	2,638	2,787	2,731	2,731	2,492	2,385	2,611	2,576	2,532
Surface inflow from Mexico	101	104	109	100	146	158	158	159	245	270	262	267
Subsurface inflow												
Coachella Canal	54	54	54	54	54	54	54	54	54	54	54	54
Westside	15	15	15	15	15	15	15	15	15	15	15	15
Mexico	7	7	7	7	7	7	7	7	7	7	7	7
Precipitation	70	268	258	217	116	215	125	250	287	169	190	194
TOTAL	3,181	3,189	3,107	3,031	3,125	3,180	3,090	2,977	2,993	3,126	3,104	3,069
Use												
Crop consumptive use (a)	1,805	1,827	1,807	1,758	1,763	1,811	1,812	1,760	1,705	1,807	1,847	1,807
Consumptive use (minor items)	34	36	36	38	40	38	37	36	35	36	35	36
Water Surface Evaporation	30	30	30	30	30	30	30	30	31	31	31	31
Consumptive Use of native vegetation	13	38	35	41	20	30	21	34	41	18	29	26
Consumptive use of phreatophytes	67	67	67	67	67	67	67	67	67	67	67	67
TOTAL	1,949	1,998	1,975	1,934	1,920	1,976	1,967	1,928	1,879	1,959	2,009	1,967
Difference supply and use	1,232	1,191	1,132	1,097	1,205	1,204	1,123	1,049	1,114	1,167	1,095	1,102
<u>Inflow to Salton Sea</u>												
Alamo River	682	639	615	603	635	642	592	543	552	564	510	499
New River	435	435	413	393	458	455	433	416	477	512	489	512
Drains flowing directly to sea	113	115	102	99	110	105	96	88	83	89	94	89
Subsurface outflow	2	2	2	2	2	2	2	2	2	2	2	2
TOTAL	1,232	1,191	1,132	1,097	1,205	1,204	1,123	1,049	1,114	1,167	1,095	1,102

(a) Closure term in hydrologic balance.

TABLE 2
IMPERIAL IRRIGATION DISTRICT
WATER OPERATIONS
1975-1986

(Values in Thousands of Acre-Feet)

Type of Use	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
Water Available for Delivery												
Inflow at Drop No. 4	2,934	2,741	2,664	2,638	2,787	2,731	2,492	2,385	2,611	2,576	2,532	2,532
Plus seepage recovery	25	25	25	25	25	25	25	25	25	25	25	25
Less canal seepage	233	228	223	220	218	215	211	209	206	200	196	195
Less carriage water and operational discharge	137	137	135	135	135	135	112	90	88	88	88	88
Less canal and reservoir evaporation	18	18	18	18	18	18	18	19	19	19	19	19
Equals water delivered to users	2,571	2,383	2,313	2,290	2,441	2,388	2,415	2,199	2,097	2,329	2,298	2,255
Water flow to drains	345	340	333	330	328	325	298	274	269	263	259	258
Water Delivered (applied water)	2,513	2,323	2,254	2,226	2,375	2,324	2,352	2,138	2,037	2,267	2,236	2,193
Crops	58	60	59	64	66	64	63	61	60	62	62	62
Other users												
Consumptive Use of Applied Water												
Crops	1,778	1,720	1,696	1,668	1,713	1,719	1,758	1,655	1,586	1,729	1,767	1,727
Other uses	34	36	36	38	40	38	37	36	35	36	35	36
Applied Water Flowing to Drains												
From crops (leaching and tailwater)	735	603	558	558	662	605	594	483	451	538	469	466
Other uses	24	24	23	26	26	26	26	25	25	26	27	26
Total IID Inflow to Drains	1,104	967	914	914	1,016	956	918	782	745	827	755	750
Other Inflow to Drains and Losses	101	104	109	100	146	158	158	159	245	270	262	267
Surface inflow from Mexico	76	76	76	76	76	76	76	76	76	76	76	76
Plus Subsurface inflow	70	268	258	217	116	215	125	250	287	169	190	194
Plus Precipitation												
Less Losses (evaporation from drains, rivers, and ponds)												
Less consumptive use of phreatophytes and native vegetation	80	105	102	108	87	97	88	101	108	85	96	93
Less crop consumptive use of precipitation	27	107	111	90	50	92	54	105	119	78	80	80
Less subsurface outflow	2	2	2	2	2	2	2	2	2	2	2	2
Equals other inflow	126	222	216	181	187	246	203	265	367	338	338	350
Total Surface Outflow from IID	1,230	1,189	1,130	1,095	1,203	1,202	1,121	1,047	1,112	1,165	1,093	1,100

TABLE 3

Table 5-2 - Water Deliveries and Consumptive Use^a
for Miscellaneous Uses (AF)

Type of Use	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
Delivered Water										
Municipal water use	24,922	24,513	23,006	26,229	26,003	27,170	26,977	26,916	26,812	27,870
Rural residential use	6,700	6,700	6,500	7,000	7,200	7,700	7,100	7,300	6,500	7,300
Industrial use	6,162	6,776	7,225	6,000	7,150	5,302	6,531	5,526	2,860	2,760
Geothermal water use	0	0	0	96	416	710	947	1,091	940	1,023
Schools, cemeteries, and golf courses	3,400	3,400	3,400	3,400	3,400	3,400	3,400	3,400	3,400	3,400
Feedlots	8,900	10,700	10,000	11,700	13,600	11,600	10,500	10,300	11,200	11,700
Lakes (Wheat, Sunbeam, Flinney, and Raser)	5,070	5,010	5,070	5,070	5,070	5,070	5,070	5,070	5,070	5,070
Military (U.S. Naval Air Station)	500	500	500	576	554	564	566	572	663	746
Wildlife areas (excludes use of drain water)	0	0	0	0	0	0	0	0	0	0
Miscellaneous service pipes	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000
Total	57,658	59,609	59,361	63,759	65,833	63,596	63,091	61,175	59,745	61,871
Consumptive Use of Delivered Water										
Municipal water use	12,461	12,272	11,943	13,114	13,002	13,505	13,488	13,458	13,406	13,935
Rural residential use	3,350	3,350	3,250	3,300	3,600	3,050	3,550	3,650	3,400	3,650
Industrial use	5,546	6,090	6,502	6,199	7,011	6,044	5,816	4,013	2,514	2,404
Geothermal water use	3	0	0	72	312	532	710	818	705	767
Schools, cemeteries, and golf courses	2,550	2,550	2,550	2,550	2,550	2,550	2,550	2,550	2,550	2,550
Feedlots	8,155	10,165	11,115	12,730	11,020	9,975	9,885	10,640	11,115	11,115
Land being reclaimed	145	116	75	142	46	250	278	990	1,294	1,068
Lakes (Wheat, Sunbeam, Flinney, and Raser)	0	0	0	0	0	0	0	0	0	0
Military (U.S. Naval Air Station)	250	250	290	260	277	282	283	286	332	314
Miscellaneous service pipes	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
Total	33,615	35,685	35,700	39,238	40,402	37,663	37,434	35,620	34,607	35,875

TABLE 5

SENSITIVITY OF TAILWATER VALUE
TO CHANGES IN OTHER VALUES

	<u>1986</u> <u>Estimate</u>
Tailwater value can be increased by	186,000
1. Decrease in estimated amount of leaching(a)	280,000
2. Decrease in estimated amount of subsurface inflow	76,000
3. Decrease in estimated amount of canal seepage or operational spill	283,000
4. Increase in estimated amount of evaporation from drains, rivers and ponds	12,000
5. Increase in estimated amount of consumptive use by native vegetation and phreatophyte	93,000
6. Increase in estimated amount of consumptive use of rainfall by crops	80,000
7. Increase in measured flow to Salton Sea from IID	1,100,000
8. Increase in estimated recovery of seepage for reuse	25,000
(a) All leaching assumed to be from applied water. If excess rainfall causes leaching and offset part of 280,000 acre- feet than calculated tailwater is increased by a like amount.	

TABLE 5

IMPERIAL IRRIGATION DISTRICT
WATER OPERATIONS
1975-1986

(Values in Thousands of Acre-Feet)

Type of Use	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
Water Available for Delivery												
Inflow at Drop No. 4	2,934	2,741	2,664	2,638	2,787	2,731	2,731	2,492	2,385	2,611	2,576	2,
Plus seepage recovery	25	25	25	25	25	25	25	25	25	25	25	25
Less canal seepage	233	228	223	220	218	215	211	209	206	200	196	
Less carriage water and operational discharge	137	137	135	135	135	135	112	90	88	88	88	
Less canal and reservoir evaporation	18	18	18	18	18	18	18	19	19	19	19	
Equals water delivered to users	2,571	2,383	2,313	2,290	2,441	2,388	2,415	2,199	2,097	2,329	2,298	2,
Water flow to drains	345	340	333	330	328	325	298	274	269	263	259	
Water Delivered (applied water)												
Crops	2,513	2,323	2,254	2,226	2,375	2,324	2,352	2,138	2,037	2,267	2,236	2,
Other users	58	60	59	64	66	64	63	61	60	62	62	
Consumptive Use of Applied Water												
Crops	1,778	1,720	1,695	1,668	1,713	1,719	1,758	1,655	1,586	1,729	1,767	1,
Other uses	34	36	36	38	40	38	37	36	35	36	35	
Applied Water Flowing to Drains												
From crops (leaching and tailwater)	735	603	558	558	662	605	594	493	451	538	469	
Other uses	24	24	23	26	26	26	26	25	25	26	27	
Total IID Inflow to Drains	1,104	967	914	914	1,016	956	918	782	745	827	755	
Other Inflow to Drains and Losses												
Surface inflow from Mexico	101	104	109	100	146	158	158	159	245	270	262	
Plus Subsurface inflow	76	76	76	76	76	76	76	76	76	76	76	
Plus Precipitation	70	268	258	217	116	215	125	250	287	169	190	
Less losses (evaporation from drains, rivers, and ponds)	12	12	12	12	12	12	12	12	12	12	12	
Less consumptive use of phreatophytes and native vegetation	80	105	102	108	87	97	88	101	108	85	96	
Less crop consumptive use of precipitation	27	107	111	90	50	92	54	105	119	78	80	
Less subsurface outflow	2	2	2	2	2	2	2	2	2	2	2	
Equals other inflow	126	222	216	181	187	246	203	265	367	338	338	
Total Surface Outflow from IID	1,230	1,189	1,130	1,095	1,203	1,202	1,121	1,047	1,112	1,165	1,093	1,

12
93
80
2
50
00

TABLE 4 (Cont.)
DETAIL FOR IID WATER BALANCE

Line		Year				
		: 1982	: 1983	: 1984	: 1985	: 1986
<u>Consumptive Use of Rain on Cropped Areas (9) 2 x 5</u>						
29		105,000	119,000	78,000	80,000	80,000
30	Precipitation on Area in AF 1 x 4	240,000	282,000	169,000	185,000	184,000
31	Storm Inflow (est.)	10,000	5,000	--	5,000	10,000
32	Total Precipitation in Balance	250,000	287,000	169,000	190,000	194,000
33	Rainfall not Consumed <u>32-29-28</u>	110,800	126,000	73,100	81,000	88,000
<u>Adjustment to Drop No. 4 KAF</u>						
34	Inflow at Drop No. 1	2,516	2,416	2,647	2,617	2,576
35	Total Diversions (9)	2,496	2,389	2,615	2,582	2,538
36	Total loss <u>34-35</u>	20	27	32	35	38
37	Deliveries to East Mesa	4	4	4	6	6
38	Flow at Drop No. 4 <u>35-37</u> (10)	2,492	2,385	2,611	2,576	2,532
<u>Comparison of Crop Consumptive Use of Applied Water KAF</u>						
39	from water Balance	1,655	1,586	1,729	1,767	1,727
40	from Unit use - Alfalfa @ 5.4'	1,833	1,634	1,755	1,670	1,638
41	from Unit use - Alfalfa @ 4,83'	1,742	1,540	1,655	1,573	1,542
<u>Canal Seepage</u>						
42	Miles of Canal lined in year	19	23	42	31	6
43	Change in Canal seepage @ 135 AF/MI/YR	-2,565	-3,105	-5,670	-4,185	-810
44	Estimated Canal seepage (11)	209,000	206,000	200,000	196,000	195,000

- (1) Rainfall at Imperial.
- (2) 55% based on 1977-79.
- (3) First 1/2" per month plus 50% over 1/2".
- (4) 600,000 acre in 1975 adjusted for rise in Salton Sea.
- (5) For calculation of C.U. of precipitation on native vegetation.
- (6) 2,000 MI x 8' wide.
- (7) at 6' per year.
- (8) at 6' per year.
- (9) Total Diversions
Includes diver
diversion to E

. (IID Annual Report)
on above EHL from AAC,

- (10) Assumes all lo
- (11) Based on B of
below Drop No.
- (12) Areas in 1983

of 252,000 AF and 200,000 AF
and changed annually by miles of canal lined.

TABLE 4
DETAIL FOR IID WATER BALANCE

Line	Year				
	: 1982	: 1983	: 1984	: 1985	: 1986
<u>Data</u>					
1 Rainfall - Total (1)	4.84	5.72	3.43	3.74	3.73
2 Rainfall - Effective (irrigated area) (2)	2.7	3.1	1.9	2.1	2.1
3 Rainfall - C.U. on Native Vegetation (3)	3.67	4.23	2.69	2.96	2.68
<u>Acres in Acres</u>					
4 Study Area (4)	593,875	592,345	592,430	592,100	592,100
5 Less Cropped Area (12)	465,500	446,000	450,000	457,700	459,000
6 Less Water Surface Area	5,309	5,374	5,374	5,374	5,374
7 Less Phreatophytes Area	11,100	11,100	11,100	11,100	11,100
8 Net Area in Cities & Low Water Using Areas (5)	111,966	116,871	79,956		
<u>Water Surface Areas</u>					
9 IID Canals Downstream of Drop No. 4	3,000	3,000	3,000	3,000	3,000
10 Farm Canals	220	220	220	220	220
11 Drains	700	700	700	700	700
12 Lakes	600	600	600	600	600
13 Fish Farms (in cropped area)	0	0	0	0	0
14 New & Alamo Rivers	670	670	670	670	670
15 Reservoirs	119	184	184	184	184
16 Subtotal - Above delivery point	3,119	3,184	3,184	3,184	3,184
17 Subtotal - Below delivery point	2,190	2,190	2,190	2,190	2,190
18 Total	5,309	5,374	5,374	5,374	5,374
<u>Phreatophyte Area in Acre</u>					
19 Measured from Quads	3,000	3,000	3,000	3,000	3,000
20 Along Canals & Drains (6)	1,900	1,900	1,900	1,900	1,900
21 Along New & Alamo Rivers	5,200	5,200	5,200	5,200	5,200
22 Miscellaneous	1,000	1,000	1,000	1,000	1,000
23 Total	11,100	11,100	11,100	11,100	11,100
<u>Precipitation, Evaporation and Consumptive Use</u>					
Evaporation from Water Surfaces AF (7)					
24 Upstream of Delivery Point	18,700	19,100	19,100	19,100	19,100
25 Downstream of Delivery Point	13,100	13,100	13,100	13,100	13,100
26 Consumptive Use of Phreatophytes (8)	66,600	66,600	66,600	66,600	66,600
27 Consumptive Use of Rain on Native Vegetation <u>3 x 8</u>	34,200	41,200	17,900	29,000	26,000

WATER BALANCE
OF IMPERIAL VALLEY

1975-1986
THESES

Water Requirements 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986

Surface 2,934 2,741 2,664 2,588 2,787 2,731 2,731 2,492 2,385 2,611 2,576 2,532

Cultivated River Inflow at 101 104 109 100 146 158 158 159 245 270 262 267

Subsurface Inflow into Mexico 54 54 54 54 54 54 54 54 54 54 54 54 54

Cochella Canal 15 15 15 15 15 15 15 15 15 15 15 15 15

Hexsite Hexsite 7 7 7 7 7 7 7 7 7 7 7 7

Precipitation 70 268 258 227 216 215 250 287 287 190 194

TOTAL 3,181 3,189 3,107 3,031 3,125 3,180 3,090 2,977 2,993 3,126 3,104 3,069

Crop consumptive use (a) 1,805 1,827 1,807 1,759 1,763 1,811 1,760 1,785 1,807 1,847 1,907

TOTAL 1,949 1,998 1,975 1,934 1,920 1,976 1,967 1,928 1,879 1,959 2,009 1,967

Difference supply and use 1,232 1,191 1,132 1,097 1,205 1,204 1,123 1,049 1,114 1,167 1,095 1,102

Inflow to Salton Sea 1,232 1,191 1,132 1,097 1,205 1,204 1,123 1,049 1,114 1,167 1,095 1,102

Alamo River 682 639 615 603 635 642 592 543 552 564 510 499

New River 435 435 413 393 458 455 433 416 477 512 489 512

Deltas flowing directly to sea 113 115 102 99 110 105 96 88 83 89 94 89

Subsurface outflow 2 2 2 2 2 2 2 2 2 2 2 2

(a) Closure term in hydrologic balance.

Attachment 13
Revised 4/87

FACSIMILE CHART IS IN
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FACTS ARE NOTED

SHEET 2 of

6-16

IMPERIAL IRRIGATION DISTRICT
AGRICULTURAL WATER USE EFFICIENCY

<u>Item</u>	<u>1977-79</u>	<u>1982</u>	<u>1986</u>
<u>Data</u>			
Irrigated Area, Ac. (1)	457,000	465,500	459,000
Diversion Below Drop No. 1, AF (2)	2,723,000	2,516,000	2,567,000
Agricultural Diversion Below Drop No. 1, AF (3)(a)	2,650,000	2,446,000	2,505,000
Agricultural Deliveries, AF (4)	2,285,000	2,138,000	2,193,000
Total Deliveries, AF (5)	2,348,000	2,199,000	2,255,000
Consumptive Use of Applied Irrigation Water, AF (6)	1,692,000	1,655,000	1,727,000
Leaching Requirement, AF (7)	280,000	280,000	280,000
<u>Agricultural Efficiency</u>			
Conveyance System Efficiency (4) (3)	86.2%	87.4%	87.5%
On-Farm Irrigation Efficiency (6) (4)	74.0%	77.4%	78.8%
District Irrigation Efficiency (6) (3)	63.8%	67.7%	68.9%
Unit Irrigation Efficiency ((6)+(7)) (4)	86.3%	90.5%	91.5%

(a) By ratio of total deliveries.

IMPERIAL IRRIGATION DISTRICT
UNIT AGRICULTURAL WATER USE AND EFFICIENCY

<u>Item</u>	<u>1977-79</u>	<u>1982</u>	<u>1986</u>
<u>Data</u>			
Irrigated Area, Ac.	457,048	465,500	459,000
Agriculture Diversion Below Drop No. 1, AF/Ac.	5.80	5.25	5.46
Agricultural Deliveries, AF/Ac.	5.00	4.59	4.78
Consumptive Use of Applied Irrigation Water, AF/Ac.	3.70	3.56	3.76
Leaching, AF/Ac.	.61	.60	.61
Tail Water AF/Ac.	.69	.43	.41
<u>Agricultural Efficiency</u>			
Conveyance System Efficiency	86.2%	87.4%	87.5%
On-Farm Irrigation Efficiency	74.0%	77.4%	78.8%
District Irrigation Efficiency	63.8%	67.7%	68.9%
Unit Irrigation Efficiency	86.3%	90.5%	91.5%

DELIVERY EFFICIENCIES OF IRRIGATION DISTRICTS(a)

Irrigation Districts	: 1975	: 1976	: 1977	: 1978
Imperial Irrig. Dist.				
onfarm efficiency	73	80	81	77
district efficiency	65	71	73	70
Coachella Valley I.D.				
onfarm efficiency	51	50	55	53
district efficiency	43	44	46	46
Reservation Div. I.D.				
onfarm efficiency	45	47	58	60
district efficiency	36	38	47	50
Y.C.W.U.A. (Valley Div.)I.D.				
onfarm efficiency	64	80	71	72
district efficiency	49	60	54	52
Yuma Mesa Irr.&D.D.				
onfarm efficiency	33	33	29	32
district efficiency	30	30	27	30
Unit "B" Irrig. Dist.				
onfarm efficiency	33	32	35	38
district efficiency	32	31	33	36
Yuma Irrigation Dist.				
onfarm efficiency	62	63	61	61
district efficiency	59	61	59	53
North Gila Irrig. Dist.				
onfarm efficiency	29	40	46	42
district efficiency	28	30	43	40
Wellton-Mohawk Irrig. Dist.				
onfarm efficiency	55	52	63	64
district efficiency	50	47	57	57
Colorado Riv. Indian Tribes				
onfarm efficiency	57	65	76	64
district efficiency	44	50	58	48
Palo Verde Irrig. Dist.				
onfarm efficiency	46	33	45	42
district efficiency	36	26	35	33

(a) Source U.S. Bureau of Reclamation, 1979. Published as Table 10 in DWR Report, December 1981.

IMPERIAL IRRIGATION DISTRICT

WATER SUPPLY AND DELIVERIES, IRRIGATED AREA AND FLOW TO SALTON SEA

Year	Water Received			Water Delivered to Users			Area Irrigated			IID Intake		
	Amount 1000 AF (a)	5-Year Moving Average in %	Departure From (a)(b)	Amount 1000 AF (a)	5-Year Moving Average in %	Departure From (c)	Amount 1000 AF (c)	5-Year Moving Average in %	Departure From (d)	Amount 1000 AF (d)	5-Year Moving Average in %	
1960	2,984	7.3	2,396	2,396	-2.4	434.5	-2.8	1,011	997	997	1,011	
61	2,957	6.3	2,416	2,416	-1.5	435.5	-2.6	1,030	997	997	1,030	
62	2,951	6.1	2,446	2,446	-0.3	429.5	-3.9	1,090	954	954	1,090	
63	2,991	7.6	2,514	2,514	2.4	430.5	-3.7	836	891	891	836	
64	2,770	2,931	-0.4	2,399	-2.2	431.5	-3.5					
1965	2,624	2,859	-5.6	2,312	2,417	-5.8	432.5	-3.2	809	919	919	809
66	2,818	2,831	1.3	2,470	2,428	0.7	437.5	-2.1	931	954	954	931
67	2,720	2,785	-2.2	2,365	2,412	-3.6	435.5	-0.3	954	977	977	954
68	2,806	2,748	0.9	2,476	2,404	0.9	441.0	-1.3	827	871	871	827
69	2,676	2,729	-3.8	2,352	2,395	-4.2	441.5	-1.2	889	911	911	889
1970	2,755	2,755	-0.9	2,418	2,416	-1.5	437.5	-2.1	947	912	912	947
71	2,884	2,768	3.7	2,535	2,429	3.3	442.0	-1.1	1,019	942	942	1,019
72	2,847	2,794	2.4	2,531	2,462	3.1	444.5	-0.6	990	916	916	990
73	2,956	2,824	6.3	2,670	2,501	8.8	442.0	-0.6	991	916	916	991
74	3,072	2,903	10.5	2,777	2,586	13.2	450.5	0.8	1,049	955	955	1,049
1975	3,001	2,952	7.9	2,704	2,643	10.2	456.5	-2.1	1,054	1,071	1,071	1,054
76	2,784	2,932	0.1	2,515	2,639	2.5	458.5	-2.6	947	947	947	947
77	2,693	2,901	-3.2	2,455	2,624	0	460.0	-2.9	922	947	947	922
78	2,672	2,844	-3.9	2,441	2,578	-0.5	452.0	-1.1	983	983	983	983
79	2,803	2,791	0.8	2,571	2,537	4.8	460.0	-2.9				
1980	2,769	2,744	-0.4	2,520	2,500	2.7	460.5	-3.0	969	966	966	969
81	2,769	2,741	-0.4	2,500	2,497	1.9	464.2	-3.8	889	942	942	889
82	2,516	2,706	-9.5	2,248	2,456	-8.4	465.3	4.1	815	916	916	815
83	2,416	2,655	-13.1	2,180	2,404	-11.2	466.0	-0.2	793	847	847	793
84	2,647	2,623	-4.8	2,386	2,367	-2.8	450.0	0.7	821	821	821	821
1985	2,617	2,593	-5.9	2,335	2,330	-4.8	457.7	2.4	757	812	812	757
1986	2,576	2,554	-7.4	2,337	2,297	-4.8	459.0	2.7	759	789	789	759
Average	2,781		2,455				447.0		933			

- (a) Data from IID Annual Reports and DWR 1981 Report.
- (b) Deliveries from 1960-1963 increased by 10 percent to adjust for rerating of Delivery Gates.
- (c) From IID Exhibit IID-H.
- (d) Attachment 21

WATER SUPPLY AND DELIVERIES, IRRIGATED AREA AND FLOW TO SALTON SEA

IMPERIAL IRRIGATION DISTRICT

Year :	Water Received			Water Delivered to Users			Area Irrigated			IID Inflow to Salton Sea		
	By District at Drop 1	Departure	Amount : 5-Year Moving Average	From	Amount : 5-Year Moving Average	Departure	Amount : 1000 AF	From	Amount : 1000 AF	Departure	Amount : 1000 AF	From
Year :	Amount : 1000 AF	Moving Average	In \$	Amount : 1000 AF	Moving Average	In \$	Amount : 1000 AF	Moving Average	In \$	Amount : 1000 AF	Moving Average	In \$
1960	2,984	7.3	2,396	-2.4	434.5	-2.8	1,011	8.4	997	5.9	10.4	
61	2,957	6.3	2,416	-1.5	435.5	-2.6	1,030	6.9	1,030	10.4	16.8	
62	2,951	6.1	2,446	-0.3	429.5	-3.9	1,090	1.2	836	9.3	-10.4	
63	2,991	7.6	2,514	2.4	430.5	-3.7						
64	2,770	2,931	-0.4	2,399	2,434	-2.2	431.5	432.3	-3.5			
1965	2,624	2,059	-5.6	2,312	2,417	-5.8	432.5	431.9	-3.2	947	930	-13.3
66	2,818	2,831	1.3	2,470	2,428	0.7	437.5	432.3	-2.1	939	939	0.2
67	2,720	2,785	-2.2	2,365	2,412	-3.6	445.5	435.5	-0.3	924	924	2.3
68	2,806	2,748	0.9	2,476	2,404	0.9	441.0	437.6	-1.3	891	891	-0.6
69	2,676	2,729	-3.8	2,352	2,395	-4.2	441.5	439.6	-1.2	902	902	-4.7
1970	2,755	2,755	-0.9	2,418	2,416	-1.5	437.5	440.6	-2.1	947	930	1.5
71	2,884	2,768	3.7	2,535	2,429	3.3	442.0	441.5	-1.1	1,019	947	9.2
72	2,847	2,794	2.4	2,531	2,462	3.1	444.5	441.3	-0.6	990	954	6.1
73	2,956	2,824	6.3	2,670	2,501	8.8	442.0	442.0	-0.6	991	967	6.2
74	3,072	2,903	10.5	2,777	2,586	13.2	444.5	443.8	0.8	1,049	999	12.4
1975	3,001	2,952	7.9	2,704	2,643	10.2	458.5	447.6	2.1	1,054	1,021	13.0
76	2,784	2,932	0.1	2,515	2,639	2.5	450.9	450.9	2.6	1,011	8.4	
77	2,693	2,901	-3.2	2,455	2,624	0	454.0	454.0	2.9	947	1,010	1.5
78	2,672	2,844	-3.9	2,441	2,578	-0.5	460.0	452.0	1.1	922	997	-1.2
79	2,803	2,791	0.8	2,571	2,537	4.8	460.0	455.5	2.9	983	983	5.4
1980	2,769	2,744	-0.4	2,520	2,500	2.7	460.5	458.2	3.0	969	966	3.9
81	2,769	2,741	-0.4	2,500	2,497	1.9	463.2	459.3	3.8	889	942	-4.7
82	2,516	2,705	-9.5	2,428	2,456	-8.4	465.3	460.3	4.1	815	916	-12.6
83	2,416	2,655	-13.1	2,180	2,404	-11.2	466.0	459.2	-0.2	793	890	-15.0
84	2,647	2,623	-4.8	2,386	2,367	-2.8	450.0	457.2	0.7	821	857	-12.0
1985	2,617	2,593	-5.9	2,335	2,330	-4.8	457.7	456.6	2.4	757	815	-18.9
1986	2,576	2,554	-7.4	2,337	2,297	-4.8	459.0	455.6	2.7	759	789	-18.6
Average	2,781			2,455			447.0			933		

(a) Data from IID Annual Reports and DWR 1981 Report.

(b) Deliveries from 1960-1963 increased by 10 percent to adjust for rating of Delivery Gates.

(c) From IID Exhibit IID-H.

(d) Attachment 21

RELATIONSHIP OF INFLOW TO SALTON SEA FROM
 IMPERIAL IRRIGATION DISTRICT TO DIVERTED
 WATER, DELIVERED WATER AND IRRIGATED AREA

Annual Values 1960-1986

	:	:	:	IID Inflow
	IID Inflow	IID Inflow	IID Inflow	to Salton Sea
Year	to Salton Sea	to Salton Sea	Delivered Water	as Ac. Ft.
	as % of	as % of		Per Ac. of
	Diverted Water	Delivered Water		Irrigated Area
1960	33.9	42.2		2.33
61	33.7	41.3		2.29
62	34.9	42.1		2.40
63	36.4	43.3		2.53
64	30.2	34.8		1.94
1965	30.8	35.0		1.87
66	33.0	37.7		2.13
67	35.1	40.3		2.14
68	33.0	37.4		2.10
69	33.2	37.8		2.01
1970	34.4	39.2		2.16
71	35.3	40.2		2.31
72	34.8	39.1		2.23
73	33.5	37.1		2.23
74	34.1	37.8		2.33
1975	35.1	39.0		2.31
76	36.3	40.2		2.21
77	35.2	38.6		2.06
78	34.5	37.8		2.04
79	35.1	38.2		2.14
1980	35.0	35.5		2.10
81	32.1	35.6		1.92
82	32.4	36.3		1.75
83	32.8	36.4		1.78
84	31.0	34.4		1.82
1985	28.9	32.4		1.65
1986	29.5	32.5		1.65

RELATIONSHIP OF INFLOW TO SALTON SEA FROM
IMPERIAL IRRIGATION DISTRICT TO DIVERTED
WATER, DELIVERED WATER AND IRRIGATED AREA

Year	Five-Year Running Average 1960-1986		
	Diverted Water	Delivered Water	Irrigated Area
1964	33.9	40.8	2.30
65	33.3	39.4	2.20
66	33.2	38.7	2.17
67	33.2	38.3	2.12
68	32.4	37.1	2.04
69	33.1	32.7	2.05
1970	33.8	38.5	2.11
71	34.2	39.0	2.14
72	34.1	38.7	2.16
73	34.2	38.7	2.19
74	34.4	38.6	2.25
1975	34.6	38.6	2.28
76	34.8	38.6	2.26
77	34.8	38.5	2.22
78	35.1	38.7	2.19
79	35.2	38.7	2.15
1980	35.2	38.6	2.11
81	34.4	37.7	2.05
82	33.9	37.3	1.99
83	33.5	37.0	1.94
84	32.7	36.2	1.87
1985	31.4	35.0	1.78
1986	30.9	34.3	1.73

RELATIONSHIP OF INFLOW TO SALTON SEA FROM
 IMPERIAL IRRIGATION DISTRICT TO DIVERTED
 WATER, DELIVERED WATER AND IRRIGATED AREA

			Five-Year Running Average 1960-1986		
Year	: Received at Drop 1 (Last Year of 5 Years)	: Water : IID Inflow : Salton Sea	: Amount of Water Received at Drop 1	: IDD Inflow to Salton Sea Per Irrigated Acre	
		: 1,000 AF	: 1,000 AF	: Per Irrigated Acre	
1964		2,931	993	432.3	6.8 2.3
1965		2,859	952	431.9	6.6 2.2
1966		2,831	939	432.3	6.5 2.2
1967		2,785	924	435.5	6.4 2.1
1968		2,748	891	437.6	6.3 2.0
1969		2,729	902	439.6	6.2 2.0
1970		2,755	930	440.6	6.3 2.1
1971		2,768	947	441.5	6.3 2.1
1972		2,794	954	441.3	6.3 2.2
1973		2,824	967	442.0	6.4 2.2
1974		2,903	999	443.8	6.5 2.3
1975		2,952	1,021	447.6	6.6 2.3
1976		2,932	1,019	450.9	6.5 2.3
1977		2,901	1,010	454.0	6.4 2.2
1978		2,844	997	455.5	6.2 2.2
1979		2,791	983	457.4	6.1 2.2
1980		2,744	966	458.2	6.0 2.1
1981		2,741	942	459.3	6.0 2.0
1982		2,706	916	460.4	5.9 2.0
1983		2,655	890	459.2	5.8 1.9
1984		2,623	857	457.2	5.7 1.9
1985		2,593	815	456.6	5.7 1.8
1986		2,554	789	455.6	5.6 1.7

COLORADO WATER USE BY CALIFORNIA AGENCIES^(a)

(Values in Thousands of Acre-Feet)

Calendar Year	All American Canal			Palo Verde Irrigation District	Yuma Project Reservation Division	Metropolitan Water District	Total
	District	District	Subtotal				
1961	3,036	522	3,558	380	40	1,054	5,032
62	3,006	565	3,571	381	46	1,029	5,027
63	3,062	538	3,600	367	45	1,065	5,077
64	2,808	511	3,319	401	50	1,092	4,862
1965	2,688	515	3,203	349	44	1,180	4,776
1966	2,886	480	3,366	407	53	1,121	4,947
67	2,770	456	3,226	364	48	1,182	4,820
68	2,864	473	3,337	393	58	1,105	4,893
69	2,714	486	3,200	391	60	1,139	4,790
1970	2,808	444	3,252	409	51	1,195	4,907
1971	2,939	466	3,405	465	49	1,207	5,126
72	2,903	501	3,404	436	47	1,220	5,107
73	3,009	512	3,521	475	48	1,165	5,209
74	3,133	552	3,685	457	44	1,125	5,311
1975	3,047	566	3,613	451	46	782	4,892
1976	2,831	516	3,347	387	47	800	4,581
77	2,717	499	3,216	431	41	1,285	4,973
78	2,715	501	3,216	425	45	715	4,401
79	2,844	523	3,367	462	49	809	4,687
1980	2,817	526	3,343	409	40	817	4,609
1981	2,839	447	3,286	518	41	825	4,670
82	2,565	420	2,985	456	58	711	4,210
83	2,509	355	2,864	322	36	903	4,125
1984	2,687	359	3,046	332	36	1,231	4,645
1985	2,678	336	3,014	387	41	1,269	4,771
1986	2,693	342	3,035	404	33	1,298	4,770

(a) Diversions less return to the River. Data from Colorado River Board.

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WATER REQUIREMENTS AND AVAILABILITY STUDY

and

WATER TRANSFER STUDY

presented to

**The Board of Directors
IMPERIAL IRRIGATION DISTRICT**

**PARSONS WATER RESOURCES, INC.
THE PARSONS CORPORATION**

**WATER REQUIREMENTS
AND AVAILABILITY STUDY**

and

WATER TRANSFER STUDY

presented to

**The Board of Directors
IMPERIAL IRRIGATION DISTRICT**

NOVEMBER 19, 1985

**PARSONS WATER RESOURCES, INC.
THE PARSONS CORPORATION**

WATER REQUIREMENTS
AND AVAILABILITY STUDY

PARSONS

OUTLINE

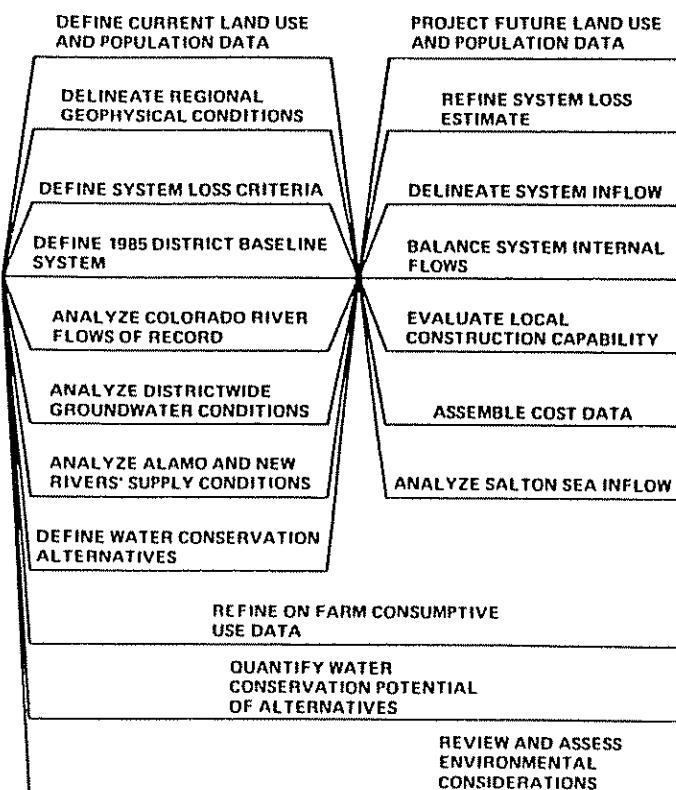
- **Purpose of the study**
- **Study methodology**
- **Findings**
 - **Water rights and supply**
 - **Water needs to year 2010**
 - **Conservation methods/program**
 - **Water availability**
- **Summary**

PURPOSE OF STUDY

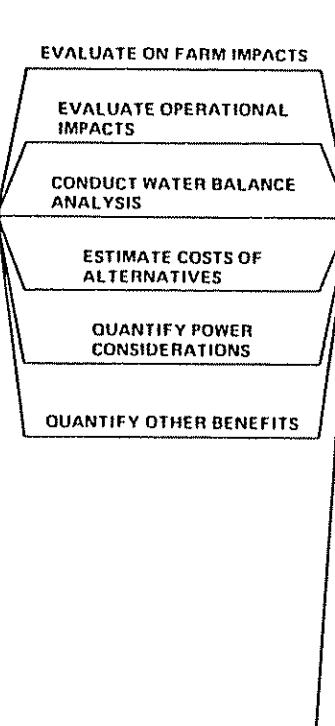
- Quantify the District's present and future water needs
- Determine the additional water that might be available for use by others

ACTIVITY DIAGRAM

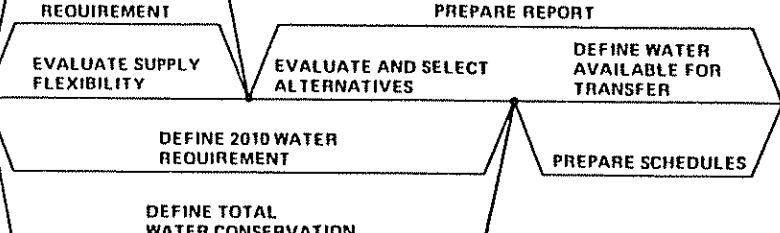
PHASE 1



PHASE 2



PHASE 3



METHODOLOGY

- **Phase 1:** Data collection/analysis/
establishment of baseline conditions and
water requirements
- **Phase 2:** Technical and economic analysis
of water conservation methods
- **Phase 3:** Determination of quantity of
additional water that might be available
for use by others — considers IID's water
availability, water needs through year
2010, and feasible conservation program

FINDINGS

IID WATER RIGHTS/SUPPLY

- **Water Rights**
 - Present Perfected: **2.6 million AF/year**
 - Seven-Party Agreement: **over 3 million AF/year**
- **Dependable supply**

3.85 million AF	Basic allotment
- 0.51 million AF	Higher priority users
<hr/>	
3.34 million AF	Available for IID

ESTIMATED WATER USE BY HIGHER PRIORITY USERS (under Seven-Party Agreement)

<u>Area</u>	Estimated Use (AF/year)
Palo Verde Irrigation District	450,000
Reservation Division - Yuma Project	60,000
Total	510,000

SUPPLY/DEMAND CONDITIONS YEAR 2010

Event Recurrence Interval (years)	Supply		Demand	
	Natural Colorado River Flow (1,000 AF/year)	Release from Storage (1,000 AF/year)	Expected Total Demand (1,000 AF/year)	Flow to California (1,000 AF/year)
2	14,300	1,100	15,400	4,400
5	10,900	4,500	15,400	4,400
10	9,200	6,200	15,400	4,400
100	5,600	9,800	15,400	4,400

FINDINGS

IID WATER REQUIREMENTS

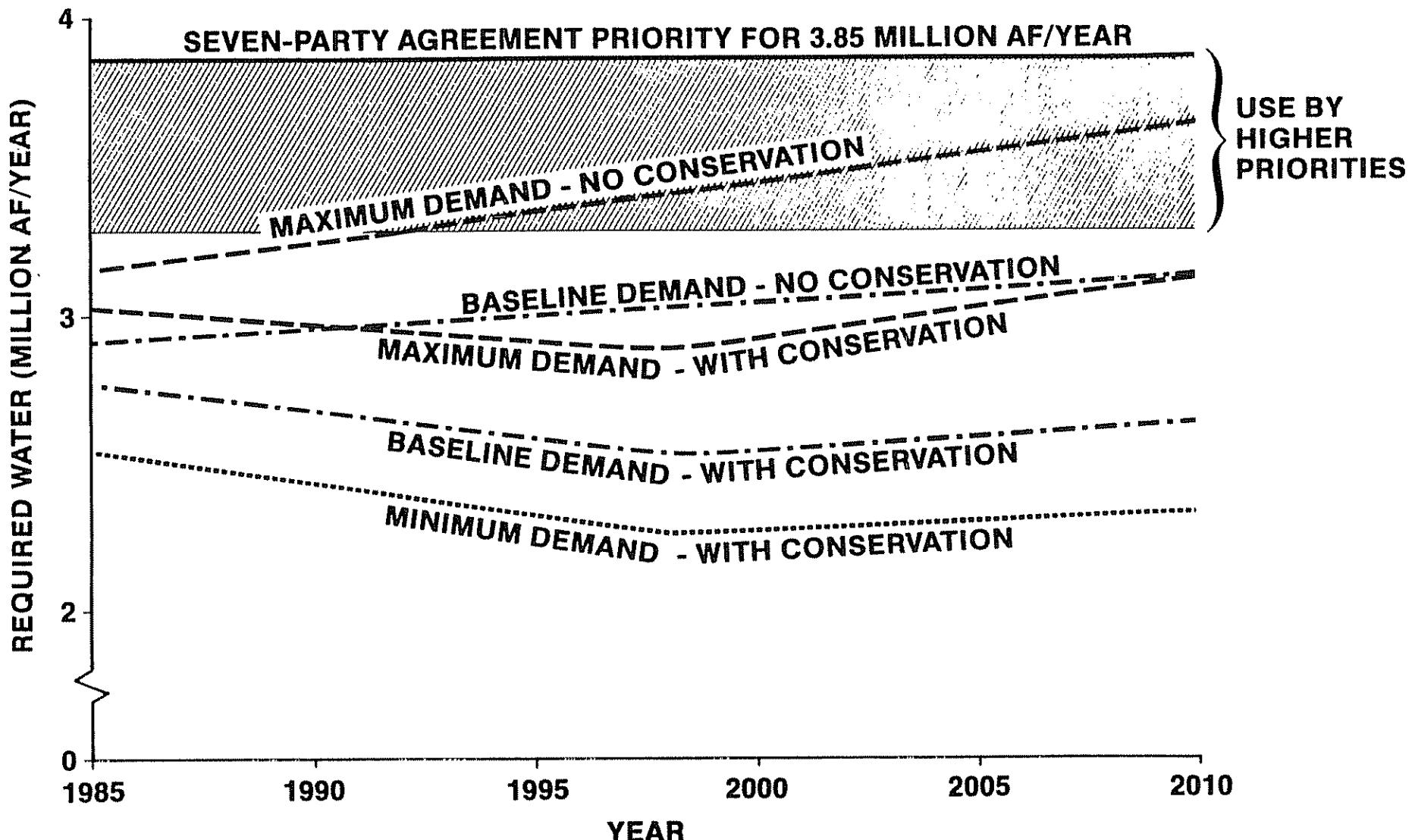
TO YEAR 2010

(1,000 AF/year)

<u>Demand Condition</u>	<u>Current Requirement</u>		<u>Year 2010 Requirement</u>		
	<u>If No Conservation</u>	<u>With Conservation</u>	<u>If No Conservation</u>	<u>If Only Pre-1986 Conservation</u>	<u>With Full Conservation</u>
Baseline	2,908	2,770	3,138	3,000	2,642
Planning maximum	3,158	3,020	3,638	3,500	3,142
Planning minimum	2,678	2,540	2,838	2,700	2,342

PARSONS

WATER REQUIREMENTS



PARSONS

FINDINGS CONSERVATION METHODS

- Structural
- Nonstructural
- On-farm

STRUCTURAL CONSERVATION METHODS

- **Canal lining**
- **Canal covering**
- **Piped delivery system**
- **Reservoirs**
- **Improved farm deliveries**
- **Improved flow-monitoring structures**
- **Nonleak gates**

STRUCTURAL CONSERVATION METHODS (Contd)

- Recovery of operational discharge**

Districtwide tailwater recovery system

Districtwide leach water recovery system

Districtwide drain water recovery system

Retention basins

- System automation and control**

- 270-mgd desalination plant for salinity control**

NONSTRUCTURAL CONSERVATION METHODS

- **Modified demand delivery**
- **Sequential water delivery**
- **Standard delivery head increments**
- **Tailwater penalties**
- **Inverted rate structure**
- **Incentive program**
- **Training programs**

ON-FARM WATER CONSERVATION METHODS

- **Land leveling**
- **Tailwater pumpback systems**
- Low-water-use crop selection**
- Head ditch lining**
- Irrigation scheduling**
- Low-water-demand irrigation methods**

PROGRAM ELEMENTS

- **Canal lining**
 - All-American Canal:
Pilot Knob to Drop No. 1
 - East Highline Canal
 - Vail Canal
 - Rositas Canal
 - Laterals

PROGRAM ELEMENTS (Contd)

- **Reservoirs**
- **Improved flow-monitoring structures**
- **Nonleak gates**
- **Recovery of operational discharge**
- **System automation**
- **Land leveling**
- **On-farm tailwater pumpback system**
- **Desalination plant**
- **Miscellaneous projects**

PROGRAM DATA

<u>Method</u>	<u>Estimated Amount Conserved (AF/year)</u>	<u>Benefit/ Cost Ratio</u>	<u>Capital Cost (\$1,000)</u>
Canal lining			
All-American Canal: Pilot Knob to Drop No. 1	51,000	1.48	\$ 32,000
East Highline Canal	46,000	1.11	39,500
Vall Canal	2,000	1.86	1,000
Rositas Canal	2,000	1.98	940
Laterals	35,000	1.13	<u>47,400</u>
Subtotal	136,000		120,840
Reservoirs			
Improved flow-monitoring structures	35,000	1.20	18,075
Nonleak gates	36,000	1.12	6,000
Recovery of operational discharge	14,000	4.95	1,426
System automation	30,000	1.10	10,400
Land levelling	27,000	1.04	15,000
On-farm tailwater recovery system	20,000	1.23	13,500
Desalination plant	20,000	1.59	7,594
Miscellaneous projects	30,000	N/A	335,000
Power offset facilities	10,000	N/A	—
Groundwater reserve system	—	N/A	40,000
Monitoring support program	—	N/A	32,000
Total	358,000		525
			\$600,360

PARSONS

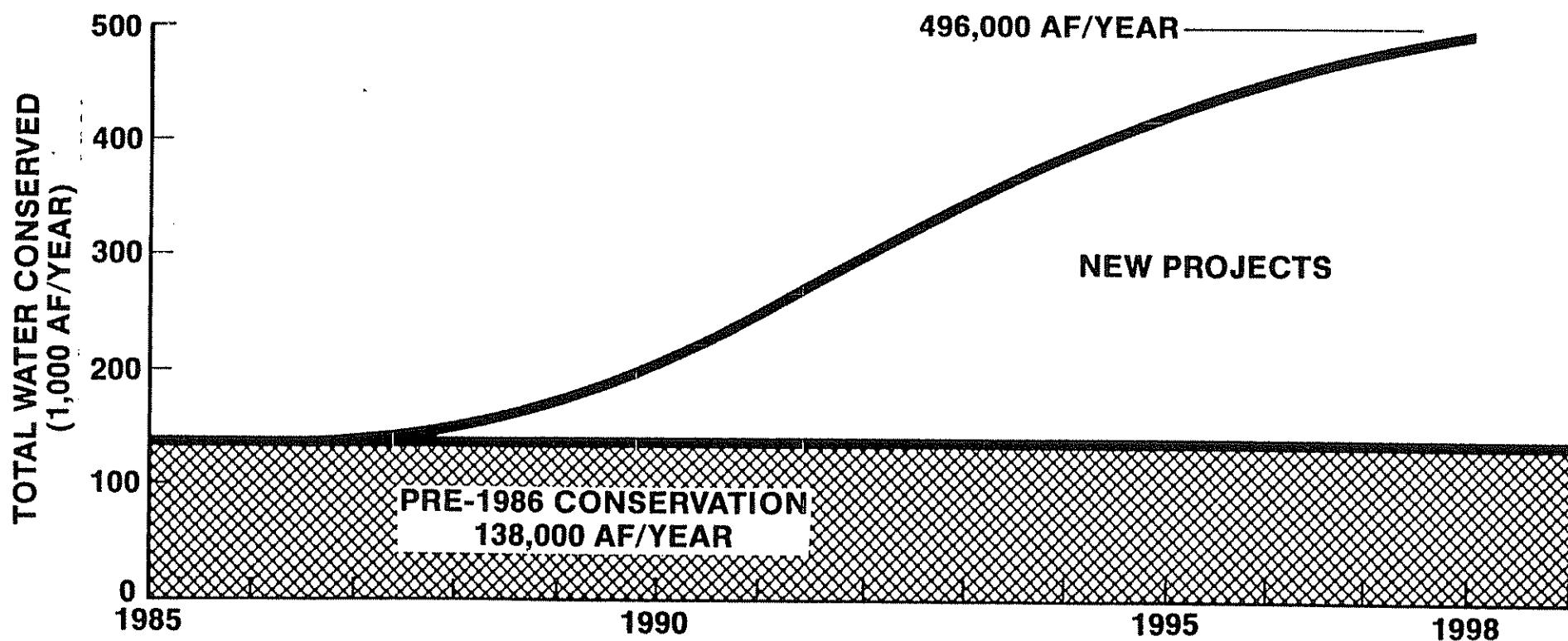
SUMMARY IMPLEMENTATION SCHEDULE

PROJECTS	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Implementation plan														
Canal lining														
All-American Canal:														
Pilot Knob to Drop No. 1					17	34	51							
East Highline Canal							10	20	30	40	46			
Vail Canal			1	2										
Rositas Canal	1	2												
Laterals	3	7	10	14	17	21	24	28	31	35				
Reservoirs	4	8	12	16	20	24	28	32	35					
Improved flow-monitoring structures	4	9	13	18	22	27	31	36						
Nonleak gates	3	6	9	14										
Recovery of operational discharge					3	6	9	12	15	18	21	24	27	30
System automation	3	6	9	12	15	18	21	24	27					
Land leveling	2	4	6	8	10	12	14	16	18	20				
On-farm tailwater recovery system	2	4	6	8	10	12	14	16	18	20				
Desalination plant			1	2	3	4	5	6	7	8	9	10		30
Miscellaneous projects														

Note: Numbers indicate estimated water conservation in 1,000 AF by each project.
 Amounts accumulate annually as projects develop and more facilities go on-line.

PARSONS

CONSERVATION DEVELOPMENT



PARSONS

FINDINGS

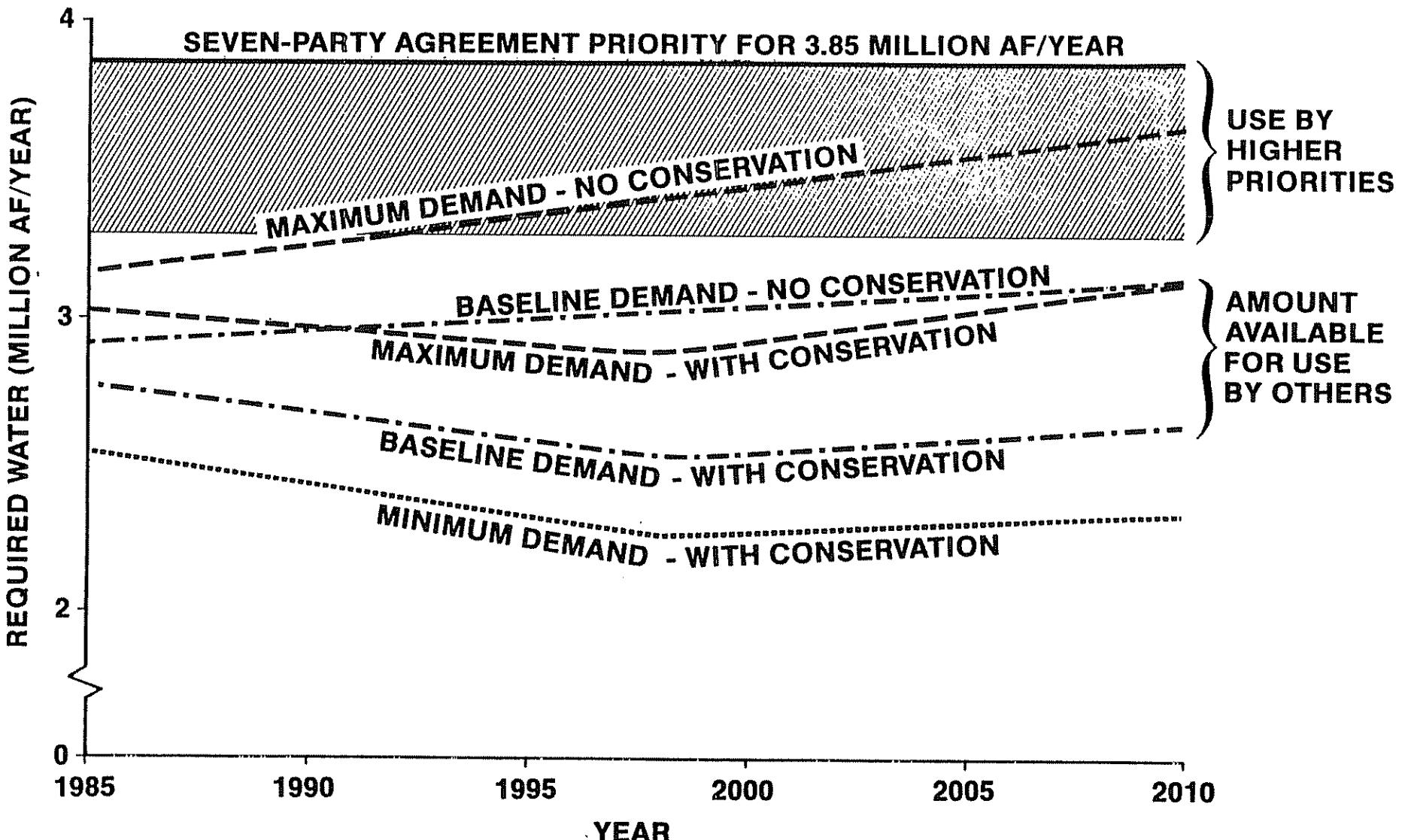
WATER AVAILABLE FOR USE BY OTHERS

138,000 AF/YEAR

358,000 AF/YEAR

496,000 AF/YEAR

WATER AVAILABLE FOR USE BY OTHERS



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SPECIAL CONSIDERATIONS

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SALINITY

1. Effect of water transfer:

100,000 AF — 2.4 ppm increase in TDS

500,000 AF — 13 ppm increase in TDS

2. Effect of other users:

824 to 904 = 80 ppm increase in TDS

(1982) (2010)

INCENTIVE PROGRAMS TO REWARD EFFICIENCY

- **Performance history allotments**
- **Acreage-based rebates**
- **Crop-based allotments**

CONTINGENCY RESERVES

- **Well field**
 - 300,000 AF/year
 - \$32,000,000
- **Dam**
 - 175,000-AF capacity
 - \$33,500,000

CONTINGENCY RESERVE SIZING

<u>Source</u>	<u>Million AF/year</u>
1. Water available through Seven-Party Agreement	3.850
2. Year 2010 “planning maximum” demand	-3.142
3. Estimated demand by higher priorities	-0.510
4. Assumed maximum amount available for transfer	<u>-0.496</u>
Required reserve	-0.298
<u>Use</u>	<u>300,000 AF/year</u>

SUMMARY

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WATER TRANSFER STUDY

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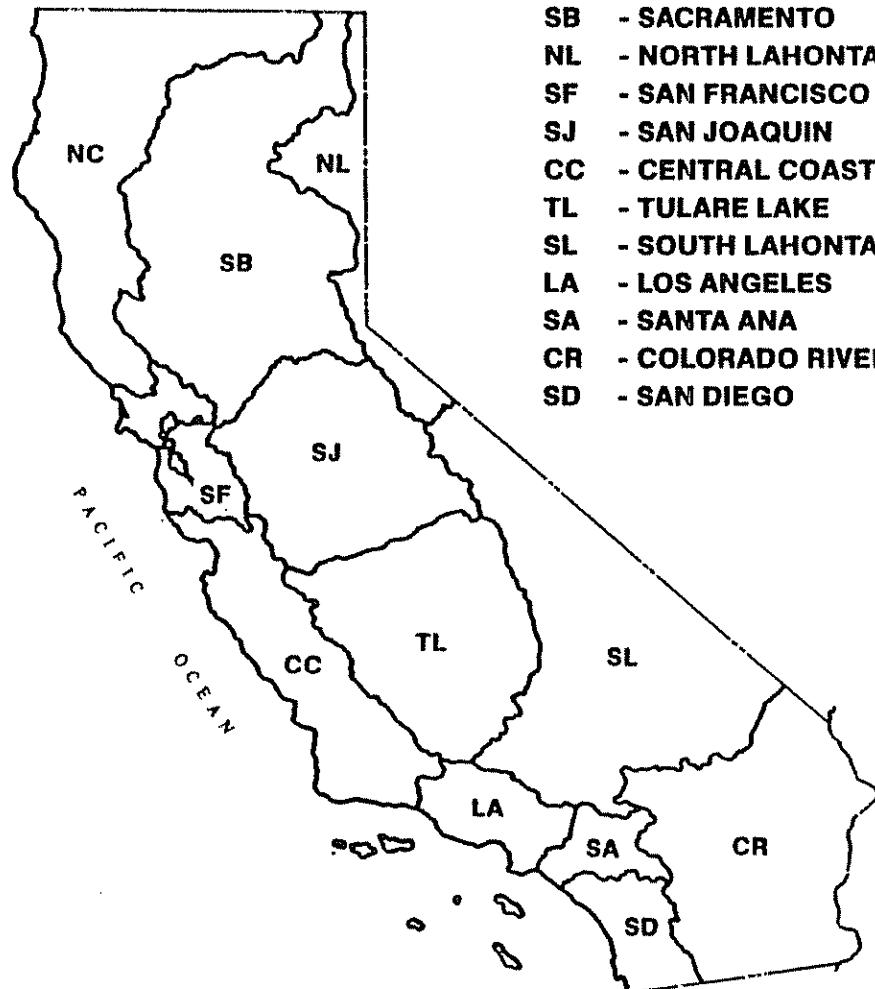
OUTLINE

- **Purpose of the study**
- **Basis of analysis and evaluation**
- **Findings**
 - **Shortages**
 - **Conveyance systems**
 - **Third-party exchange**
 - **Alternative supply**
 - **Transfer candidates**
- **Conclusions**
- **Recommendations**

PURPOSE OF STUDY

- Determine potential transferees for available conserved water**

BASIS OF ANALYSIS AND EVALUATIONS



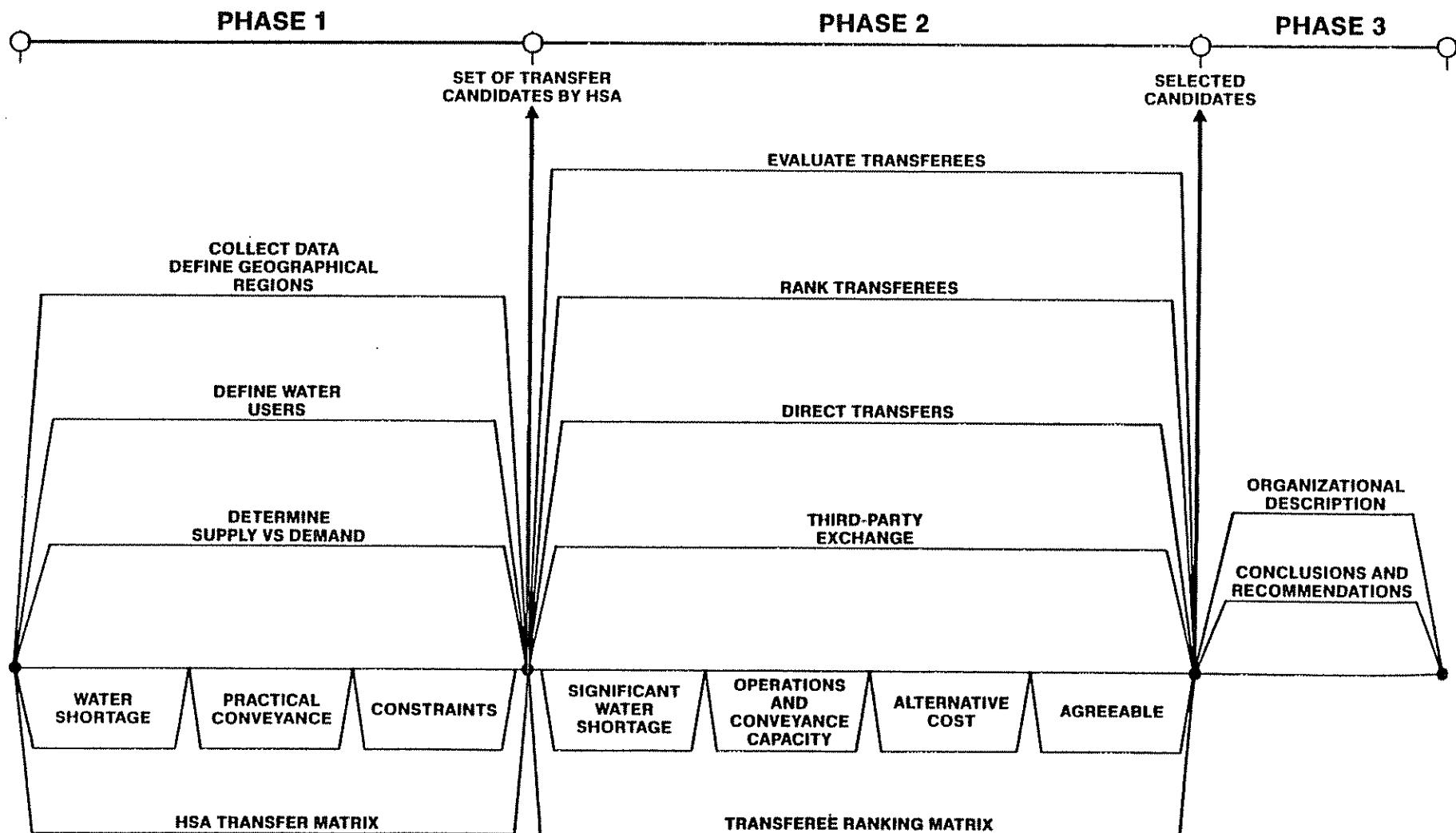
Hydrologic Study Areas of California

- Hydrologic study areas
- Southern California
- Northern California
- Used data from:
 - Department of Water Resources
 - Metropolitan Water District
 - L.A. Department of Water and Power
 - San Diego County Water Authority
 - Kern County Water Agency
 - Bureau of Reclamation
 - Interviews
 - Other

METHODOLOGY

- **Phase 1:** Data collection and analysis to establish demand and supply scenarios for determining shortages of transferee candidates. Analysis of conveyance systems and alternative supply.
- **Phase 2:** Evaluation and ranking of transferee candidates to determine suitability for transfer.
- **Phase 3:** Recommendation of the potential water transferee candidates

ACTIVITY DIAGRAM

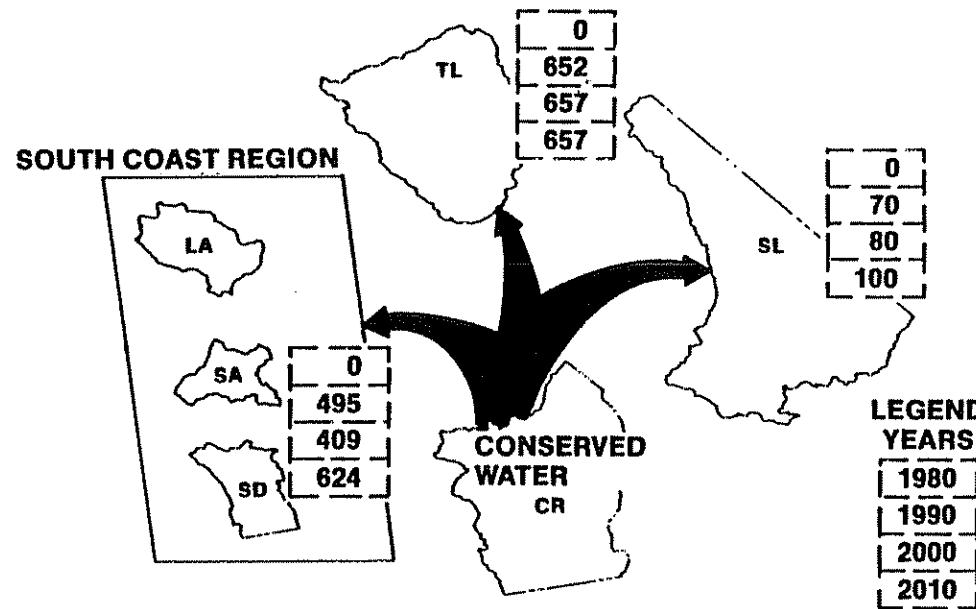


FINDINGS

- **Shortages**
- **Conveyance systems**
- **Third-party exchange**
- **Alternative supply**
- **Transferees**

SHORTAGES

- The south coast region will have increasing shortages to 624,000 AF/year by 2010

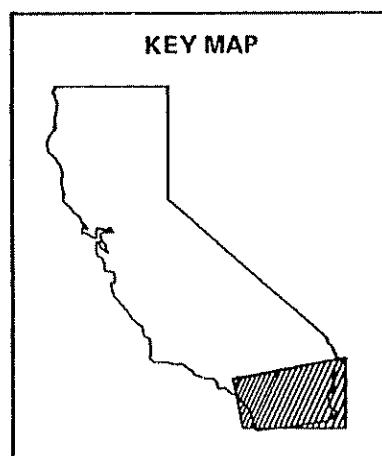
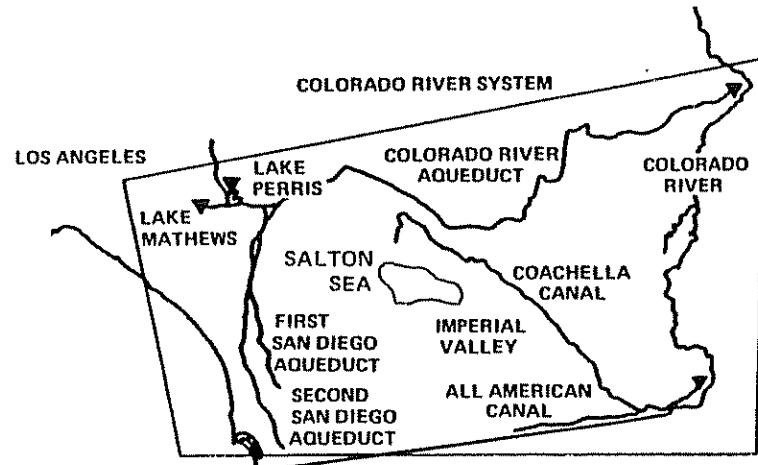


- Tulare Lake area overdraft is approximately 300,000 AF/year
- South coast groundwater is monitored at a safe yield and is currently producing at maximum yield

CONVEYANCE SYSTEMS

- **Physical direct transfer of water to the south coast from the District is feasible using existing aqueducts**
- **Colorado River Aqueduct will have capacity in 1987 to begin transfer of District-conserved water as a result of CAP withdrawal**
- **San Diego Canal/Aqueduct system has capacity to deliver 703,000 AF/year - enough capacity to meet future demands**
- **SWP East and West Branches are limited to delivering 1,200,000 AF of the 1,500,000 AF annual yield available**

COLORADO RIVER AQUEDUCT DELIVERIES AND CAPACITY



MWD's Dependable Colorado River Water Supply (1,000 AF/year)

User	1985	1990	2000	2010
MWD fourth priority	1,212	550	550	550
Indian water use	0	-47	-52	-52
Miscellaneous present perfected rights	-3	-3	-3	-3
MWD dependable diversion entitlement	1,209	500	495	495
Conveyance losses	-50	-50	-50	-50
Coachella Valley Water District-	-61	-61	-61	-78
Desert Water Agency-San Gorgonio Pass Water Agency exchange				
Desert powerplant use	0	0	-42	-42
Total MWD service area supply	1,098	389	342	325

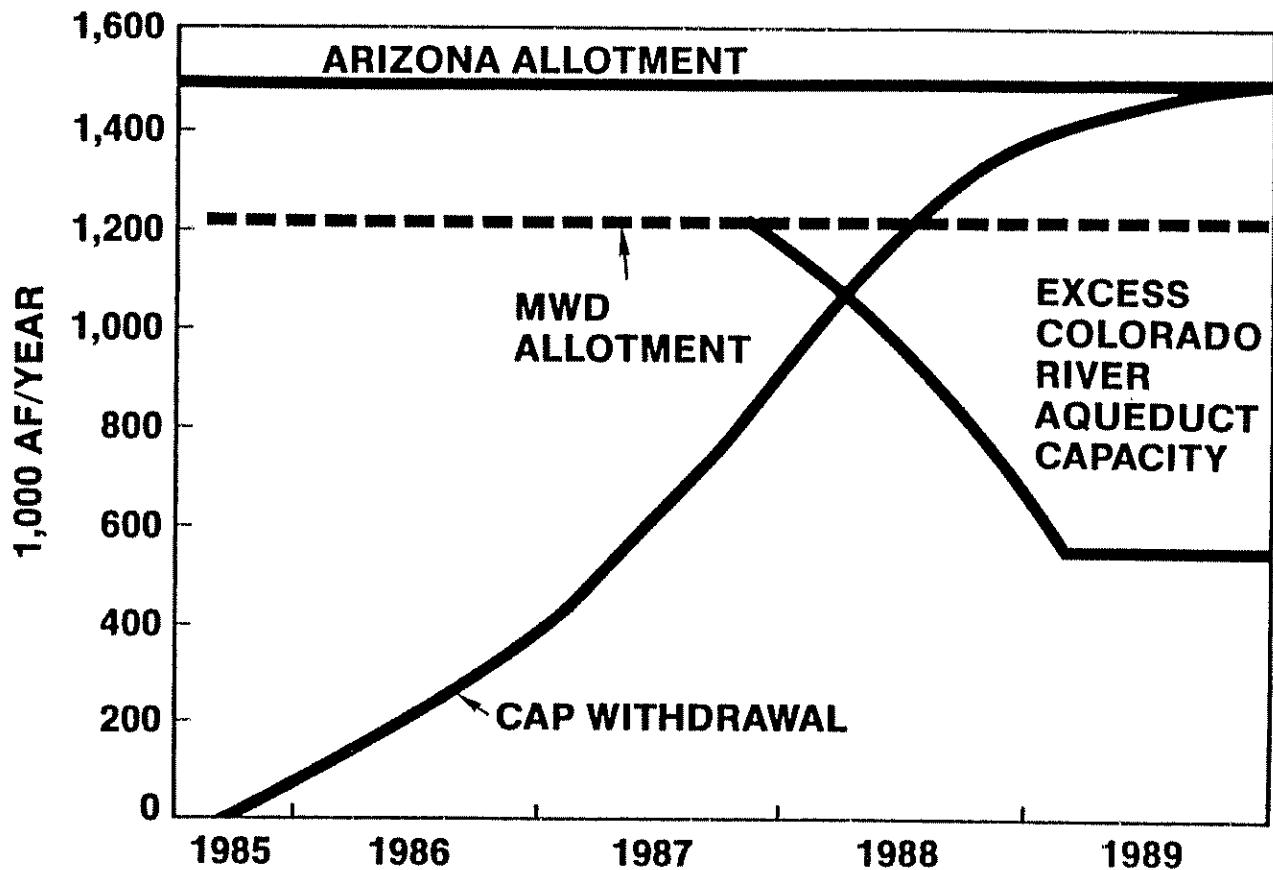
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COLORADO RIVER AQUEDUCT DELIVERIES AND CAPACITY (Contd)

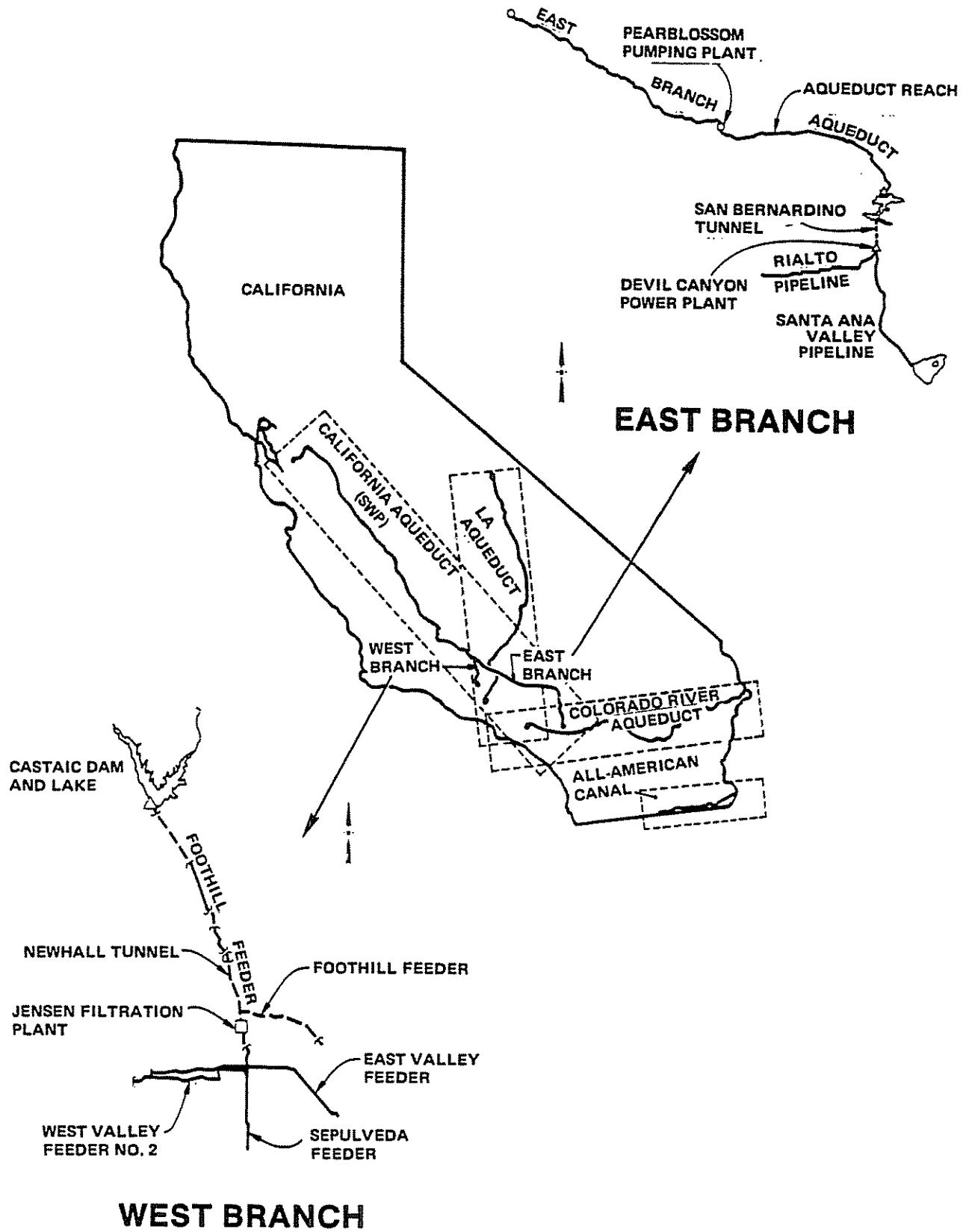
Central Arizona Project:
Estimated Water Withdrawal

Withdrawals
Pumped from
Colorado River
(1,000 AF/year)

Year	Withdrawals Pumped from Colorado River (1,000 AF/year)
1985	43
1986	372
1987	850
1988	1,380
1989	1,500



SWP DELIVERY LIMITATIONS

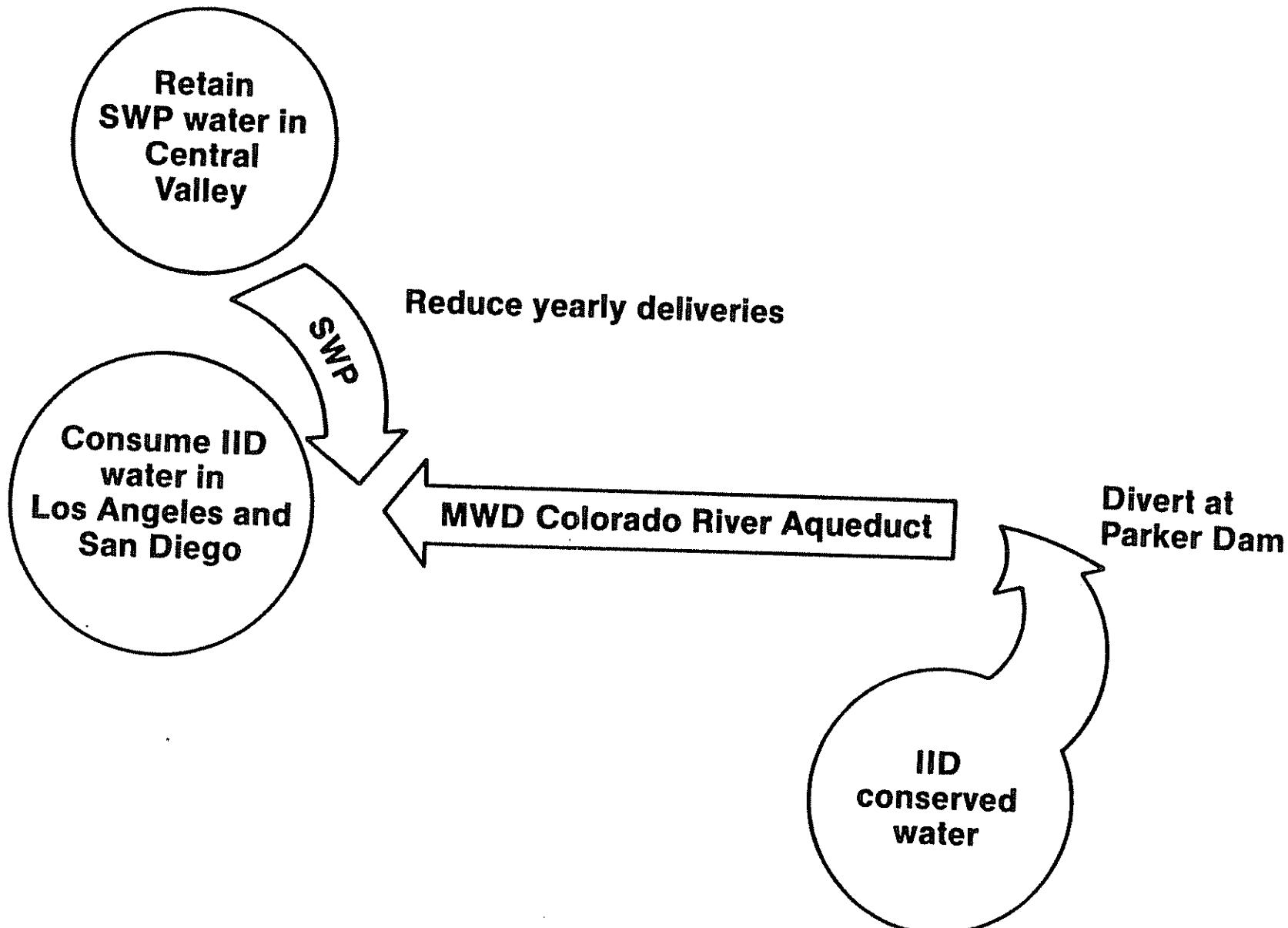


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THIRD-PARTY EXCHANGE

- To benefit from Central Valley water transfer, the District would have to arrange a third-party exchange
- Direct transfer of District water to the Tulare Lake area is not practical

TRANSFER/EXCHANGE APPROACH



ALTERNATIVE WATER SUPPLIES

- Alternative south coast supplies are:
 - Conjunctive groundwater management (interim water)
 - Reservoir management storage of peak and regulation water (interim water)
 - Reclamation
 - Other
- SWP yield development is not keeping pace with demand projections
 - Delta facilities
 - CVP surplus (interim)

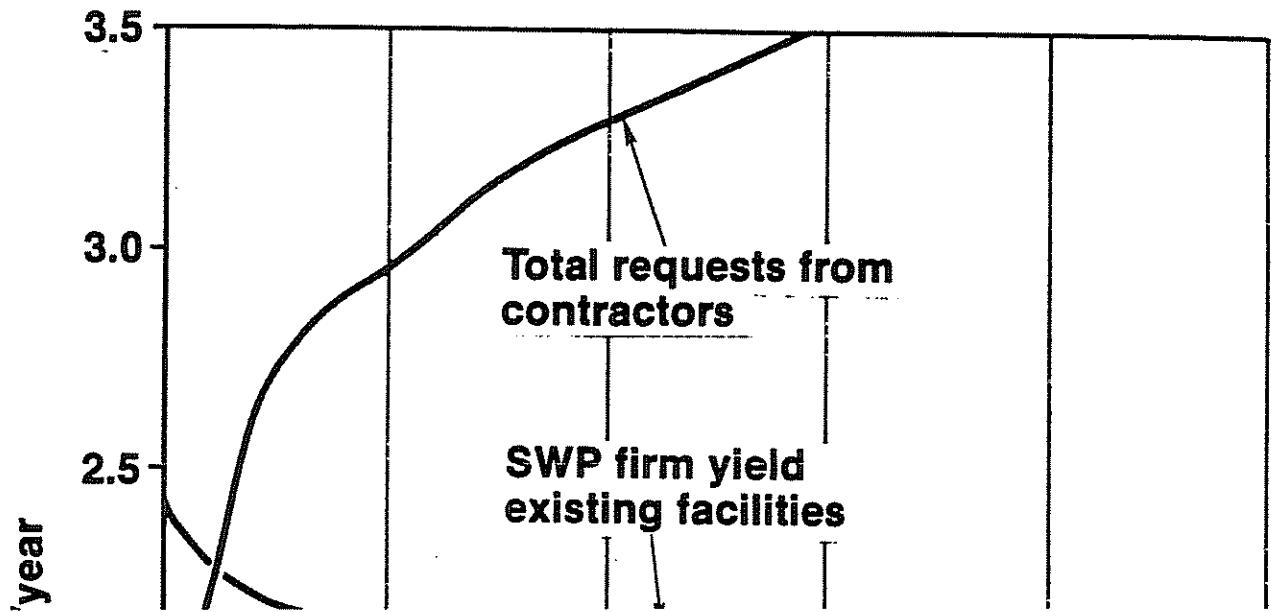
SOUTH COAST WATER SUPPLY ALTERNATIVES

<u>Supply Option</u>	<u>1990</u>	<u>2000</u>	<u>2010</u>
Groundwater	20 ^a	70 ^a	115 ^a
Reservoir	0	0	0
Reclamation	63	113 ^b	163 ^b
Other	<u>Neg</u>	<u>Neg</u>	<u>Neg</u>
Total	83	183	278

aFor replacement of overdraft or conservation of aquifers; data based on DWR study concluding 185,000 AF available by year 2025.

bMWD prediction at a development rate of 5,000 AF/year.

WATER YIELD VS CONTRACTOR REQUESTS



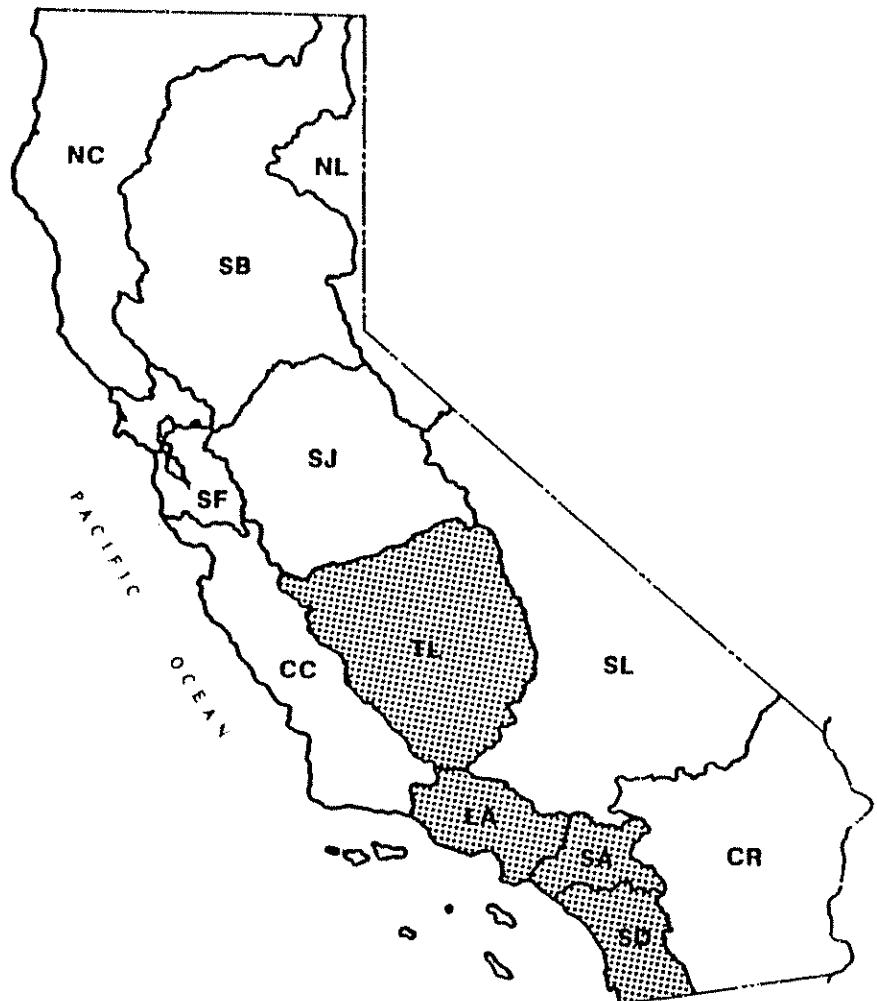
ALTERNATIVE CURRENT COST OF WATER

- 1. MWD \$220 to \$1,600** Based on firm yield of Cottonwood Creek project and other alternative sources
- 2. SDCWA \$193 to \$220** Cost of MWD supply or Cottonwood Creek project
- 3. KCWA \$45** SWP supply cost for firm yield

CANDIDATES

- Three agencies are suitable transferee candidates:
 - Metropolitan Water District
 - San Diego County Water Authority
 - Kern County Water Agency

HYDROLOGIC STUDY AREAS OF CALIFORNIA



- NC - NORTH COAST
- SB - SACRAMENTO
- NL - NORTH LAHONTAN
- SF - SAN FRANCISCO BAY
- SJ - SAN JOAQUIN
- CC - CENTRAL COAST
- TL - TULARE LAKE
- SL - SOUTH LAHONTAN
- LA - LOS ANGELES
- SA - SANTA ANA
- CR - COLORADO RIVER
- SD - SAN DIEGO

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HYDROLOGIC STUDY AREA TRANSFER MATRIX

<u>Criteria</u>	<u>Los Angeles</u>	<u>Santa Ana</u>	<u>San Diego</u>	<u>South Lahontan</u>	<u>Tulare Lake</u>
Alternative supplies					
Groundwater	+	+	+	+	+
Reservoirs	0	0	0	0	0
Reclaimed water	0	0	0	0	0
Conveyance Systems					
Aqueducts/Piping	-	+	+	-	-
Powerplants	0	0	0	-	-
Pumps	0	0	0	-	+
Operation					
Water quality	0	0	0	0	0
Reservoir management	0	0	0	0	0
Pumping plants	0	0	0	0	0
Powerplants	0	0	0	0	0
Exchange agreement	+	+	+	-	-
In-place distribution system	+	+	+	-	-
2010 shortage (AF/year)	233	115	276	100	657
Total rating	+2	+4	+4	-4	0

PARSONS

TRANSFEREE EVALUATION MATRIX

CRITERION AGENCY	(1) Shortage Quantity (1,000 AF)	(2)	(3)	(4)	(5)
	Years 1990-2010	Conveyance Capacity	Operational Compatibility	Cost of Alternative Supply	Willingness to Transfer Water
1. Metropolitan Water District of Southern California	370 to 348	Good	Fair	Good ^a \$220	Good
2. San Diego County Water Authority	125 to 276	Good	Fair	Good ^b \$193.00	Good
3. Kern County Water Agency	275 to 300	Fair ^c	Good	Poor ^d \$45.26	Fair
4. Coachella Valley Water District	0 to 0	***Not considered because of minimal need***			

TRANSFeree EVALUATION MATRIX (Contd)

^aCost per acre-foot to implement the Cottonwood Creek program. The California Senate Office of Research has predicted that southern California's unit cost per acre-foot may be as high as \$1,659.13 if the proposed water project outlined in SB 1369 would have been implemented. For reference, see "Who Pays and Who Benefits: Water Development in California," SOR Brief, June 1984.

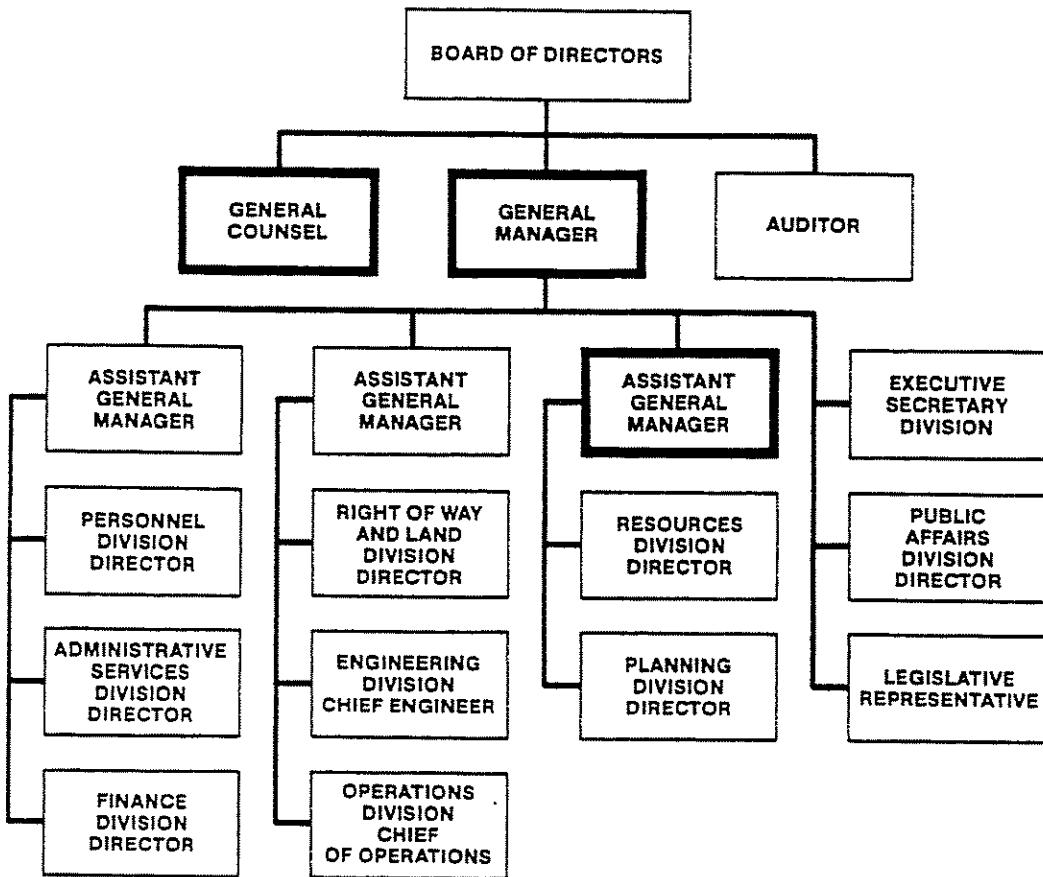
^b1985-1986 rates for MWD water.

^cThe conveyance facilities for the Kern County Water Agency are in place; however, to supply District water to Kern, an exchange of SWP water for Colorado River water is required. To facilitate an exchange, the current state contractors in the south coast area will have to be capable of using Colorado River water in lieu of SWP supply. Currently, the Desert Water Agency is using Colorado River water in lieu of its SWP entitlement. The facilities to convey this water are in place and could be expanded to transfer District water.

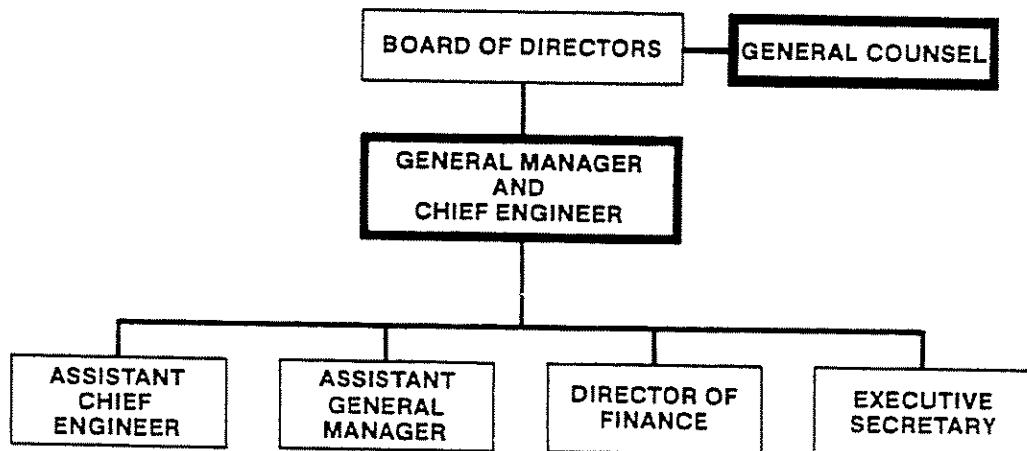
^dThe costs are provided by the DWR Bulletin 132-84, Table B-23, Equivalent Unit Charge for Water Supply for each contractor.

Source: Parsons, 1985.

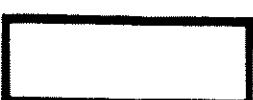
FIRST — METROPOLITAN WATER DISTRICT



SECOND — SAN DIEGO COUNTY WATER AUTHORITY



LEGEND
KEY TRANSFER
CONTRACT CONTACTS



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CONCLUSIONS

- 1. The demand for water in southern California will continue to grow over the next 25 years as a result of population increase. This is particularly true in the south coast plain.**
- 2. Water supplies in southern California will be adversely impacted by the increasing diversion of Colorado River water to Central Arizona.**
- 3. California laws and policies concerning water conservation and beneficial use support the transfer of District-conserved water.**
- 4. Transfer of conserved water surplus to local needs from the Imperial Irrigation District is feasible.**
- 5. The most appropriate transferees to receive conserved District water are located in the south coastal plain of southern California.**

CONCLUSIONS (Contd)

- 6. The most advantageous and easily implemented water transfer arrangement would involve transfer of District-conserved water to the MWD. Transfer to the San Diego County Water Authority would also be feasible but would probably be more difficult to arrange. Although more difficult, transfer to Kern County through a third-party exchange system is feasible if economic conditions change.**
- 7. Receiving conserved water from the District is an attractive alternative to other possible sources because of its present and future firm availability, location, and relative cost.**

RECOMMENDATIONS

- 1. The District should negotiate an initial water transfer agreement with the MWD that would make available water already conserved for delivery through the Colorado Aqueduct System. Additional transfer agreements with the MWD should follow as further conservation is accomplished, making water available for use by the MWD that is not needed to meet District needs. These actions will provide the required funds to ensure full implementation of the District's Water Conservation Program.**

- 2. If negotiations with the MWD are not satisfactorily completed within a reasonable time, arrangements should be made to negotiate for water transfer to the San Diego County Water Authority.**